RELATION OF APPLIED NITROGEN AND POTASSIUM TO YIELD, QUALITY AND LEAF COMPOSITION OF THE GREENHOUSE TOMATO

Freeman S. Howlett

Dale W. Kretchman

Department of Horticulture

Ohio Agricultural Research and Development Center
Wooster, Ohio

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Chart 1

Relation of Nitrogen and Potassium Applications to Yield and Quality of Greenhouse Tomatoes

Spring Crop 1966

The experimental work is being conducted in the Greenhouse No. 1 of the Ohio Agricultural Research and Development Center at Wooster.

Ammonium nitrate and potassium sulfate were applied February 8, March 1, March 22 and April 12.

Total applied in pounds for 5 treatments is as follows:

Treatment	Ammonium Nitrate (lbs)	Treatment	Potassium Sulfate (lbs)
1	0	1	0
2	88	2	130
3	300	3	445
4	512	4	760
5	600	5	890

The data obtained have been subjected to statistical analysis. The particular results reported for this crop involve the effect of the applications of nitrogen and potassium on the following yield and quality aspects:

OHIO-INDIANA HYBRID O

Number of fruits per plant

With the lower applications of nitrogen the number of fruits increased. This was followed by a marked decrease as a result of applying the larger quantities.

Weight of fruits per plant

A similar effect of increasing nitrogen was obtained.

Total defects per fruit

Total defects increased with added nitrogen throughout the entire range. At the lower levels of applied potassium/defects were greater in number than at the 3 highest levels.

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Puffiness

Puffiness was affected by both added nitrogen and potassium. It was highest at the lower potassium applications. At all but the moderate potassium level puffiness increased with added nitrogen.

Cracking

Cracking increased with added nitrogen at all levels of potassium. Less cracking occurred as potassium levels were increased.

Off-Color

Off-colored fruits increased with added nitrogen at all levels of potassium.

Off-Shape

Generally off-shaped fruits increased with added nitrogen.

Percentage of No. 1 fruits

The percentage of No. 1 fruits was significantly affected by both applied nitrogen and potassium.

The percentage of No. 1 fruits decreased with applied nitrogen. There was some indication that the percentage of No. 1 fruits was highest at the two higher potassium levels although the difference between zero potassium and the highest potassium level was small.

Weight of fruit

Weight per fruit tended to increase only up to the 3rd nitrogen level.

OHIO WR 25

Number of fruits per plant

Number of fruits per plant increased only to the 4th Nitrogen level and thereupon showed no change.

Weight of fruits per plant

Similarly the weight of fruits per plant increased to the 4th Nitrogen level and thereupon showed no change.

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Total defects per fruit

Defects increased with added nitrogen up to at least the 4th level of added nitrogen. The defects appeared to be somewhat greater at the lower potassium levels.

Puffiness

Puffiness generally tended to increase with added nitrogen up to the 3rd nitrogen level. It was appreciably less at the two higher potassium levels.

Cracking

Cracking increased with added nitrogen up to and including the 4th Nitrogen level.

Off-Color

There was no appreciable effect of added nitrogen and potassium on production of off-colored fruits.

Off-Shape

Off shape was more prevalent at the moderate potassium levels. The amount was much higher than that of off-colored fruits.

Percentage of No. 1 fruits

The percentage of No. 1 fruits increased from the highest to the lowest level of nitrogen (0 Nitrogen) at all levels of potassium.

Weight per fruit

Weight per fruit tended to increase with added nitrogen to the moderate or 3rd Nitrogen level. Potassium had relatively little effect.

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Table 1

Correlations Between Leaf Content and Fruit Yield and Defects

OHIO-INDIANA HYBRID O — Spring Crop 1966

Date	Cluster	Yield or Defect	Nutrient	Correlation Coefficients
Feb. 8	1	Defects per fruit	K	-.409
		Puffiness	None	
		Cracking	K	-.390
		Off Color	K	-.590
		Off Shape	None	
		Per cent No. 1	K	.427
		Wt. fruits per plant	N	.338
		No. fruits per plant	None	
		Weight per plant	K	-.341
Feb. 28	2	Defects per fruit	N	.693
		Puffiness	None	
		Cracking	N	.664
		Off Color	N	.478
		Off Shape	None	
		Per cent No. 1	N	-.654
		Wt. fruits per plant	N	.678
		No. fruits per plant	N	.421
		Weight per plant	N	.556
March 21	3	Defects per fruit	N	.604
		Puffiness	P	.354
		Cracking	N	.680
		Off Color	N	.561
		Per cent No. 1	N	-.535
		Wt. fruits per plant	N	.667
		No. fruits per plant	N	.483
		Weight per plant	N	.601
April 11	4	Defects per fruit	N	.623
		Cracking	N	.685
		Off Color	N	.567
		Per cent No. 1	N	-.470
		Wt. fruits per plant	N	.552
		No. fruits per plant	N	.598
		Weight per plant	N	.628
May 2	5	Defects per fruit	N	.715
		Puffiness	K	-.430
		Cracking	N	.773
		Off Color	N	.656
		Per cent No. 1	N	-.617
		Wt. fruits per plant	N	.807
		No. fruits per plant	N	.676
		Weight per plant	N	.787

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Table 1 Cont'd

Date	Cluster	Yield or Defect	Nutrient	Correlation Coefficients
June 14	5	Defects per fruit	N	.702
		Cracking	N	.762
		Off Color	N	.656
		Per cent No. 1	N	-.636
		Wt. fruit per plant	N	.654
		No. fruit per plant	N	.717
		Weight per plant	N	.754
June 14	6	Defects per fruit	N	.626
		Cracking	N	.695
		Off Color	N	.595
		Per cent No. 1	N	-.563
		Wt. fruits per plant	N	.657
		No. fruits per plant	N	.672
		Weight per plant	N	.723
June 28	7	Defects per fruit	N	.781
		Cracking	N	.818
		Off Color	N	.760
		Per cent No. 1	N	-.767
		Wt. fruits per plant	N	.715
		No. fruits per plant	N	.640
		Weight per plant	N	.727

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Table 2

Correlations Between Leaf Content and Fruit Yield and Defects

OHIO WR 25 Spring Crop 1966

Date	Cluster	Yield or Defect	Nutrient	Correlation Coefficients
Feb. 8	1	Off Shape	N	.447
		Wt. fruits per plant	N	.349
		No. fruits per plant	N	.344
		Weight per plant	N	.381
Feb. 28	2	Defects per fruit	N	.395
		Per cent No. 1	N	-.342
March 21	3	Defects per fruit	N	.436
		Cracking	N	.552
		Per cent No. 1	N	-.442
		Wt. fruits per plant	N	.517
		No. fruits per plant	N	.512
		Weight per plant	N	.542
April 11	4	Cracking	N	.372
		Wt. fruits per plant	N	.406
		No. fruits per plant	N	.382
		Weight per plant	N	.407
May 2	5	Defects per fruit	N	.412
		Puffiness	K	-.403
		Cracking	N	.525
		Per cent No. 1	N	-.346
		Wt. fruits per plant	N	.503
		No. fruits per plant	N	.413
		Weight per plant	N	.471
June 14	5	Defects per fruit	N	.528
		Puffiness	K	-.387
		Cracking	N	.742
		Per cent No. 1	N	-.556
		Wt. fruits per plant	N	.515
		No. fruits per plant	N	.749
		Weight per plant	N	.701
June 14	6	Defects per fruit	N	.527
		Puffiness	K	-.347
		Cracking	N	.744
		Per cent No. 1	N	-.576
		Wt. fruits per plant	N	.538
		No. fruits per plant	N	.720
		Weight per plant	N	.691

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Table 2 Cont'd

Date	Cluster	Yield or Defect	Nutrient	Correlation Coefficients
June 28	7	Defects per fruit	N	.621
		Cracking	N	.781
		Per cent No. 1	N	-.622
		Wt. fruits per plant	N	.521
		No. fruits per plant	N	.761
			K	.331
		Weight per plant	N	.716

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Chart 2

Relation of Nitrogen and Potassium Applications to Yield and Quality of Greenhouse Tomatoes

Spring Crop 1967

Nitrogen and potassium were applied on the following dates:

February 8
March 1
March 22
April 12
May 3

In view of the desire to take nitrate tests as a rough measure of soluble nitrogen available the fertilizer applications involved potassium nitrate, sodium nitrate and potassium sulfate.

The amounts added for 5 applications were as follows:

Nitrogen	Potassium (K)
0	0
55	100
165	315
275	530
330	630

The results upon yield and quality for both Ohio-Indiana Hybrid O and Ohio WR 25 were analyzed statistically. They are briefly summarized below for yield and quality factors.

OHIO-INDIANA HYBRID O

Number of fruits per plant

There was no significant effect from either applied nitrogen or potassium.

Weight of fruits per plant

Likewise, applied nitrogen and potassium had no significant effect on weight of fruits per plant.

Total defects per fruit

Total defects tended to increase to the third level of nitrogen and then showed a slight decrease.

Percent of No. 1 fruits

Applied nitrogen or potassium had no significant effect upon percentage of No. 1 fruit.

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Puffiness

Puffiness was greatest at the three lower nitrogen levels. It was less at the highest potassium level.

Cracking

Cracking was not significantly affected by applied nitrogen or potassium.

Scars

Scarred fruits were greater in number at the medium to higher levels of applied nitrogen. At the medium level of potassium scars took place at all nitrogen levels. At the highest nitrogen level, it was the lowest.

Off-Shape

No particular effect of nitrogen and potassium on off-shape seemed to be significant.

OHIO WR 25

Number of fruits per plant

Number of fruits per plant was not significantly affected by nitrogen levels alone. At the median potassium level, number of fruits per plant tended to increase somewhat with added nitrogen.

Weight of fruits per plant

A similar situation developed as with number of fruits.

Total defects per fruit

No statistically significant effect of applied nitrogen or potassium was found to occur. The tendency were for defects to increase with applied nitrogen to the median nitrogen application.

Percent of No. 1 fruits

No really statistical significant effect of nitrogen and potassium treatments on percent of No. 1 fruits was obtained.

Puffiness

No significant effect of nitrogen or potassium on puffiness was obtained.

Cracking

No significant effect of nitrogen or potassium on cracking was obtained. Cracking was quite high.

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Chart 2 Con't

Scars

No really statistically significant effect of nitrogen or potassium on scars was obtained.

Off-Shape

No statistically significant effect of nitrogen or potassium on off-shaped fruits was obtained. Off-shape fruits were rather high.

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Table 3

Correlations Between Leaf Content and Fruit Yield and Defects

OHIO-INDIANA HYBRID O — Spring Crop 1967

Date	Cluster	Yield or Defect	Nutrient	Correlation Coefficients
Feb. 10	1	Wt. fruits per plant	K	-.387
		Defects per fruit	N	.478
		Cracking	N	.359
		Off Shape	N	.468
		Per cent No. 1	N	-.467
			K	.389
March 3	2	Per cent No. 1	N	-.345
March 24	3	No. fruits per plant	N	.387
		Wt. fruits per plant	N	.426
		Rough fruits	K	.348
		Off Color	K	-.385
		Per cent No. 1	N	-.350
April 14	4	No. fruits per plant	N	.450
		Wt. fruits per plant	N	.546
		Defects per fruit	N	.546
		Cracking	N	.760
		Off Color	K	-.398
		Per cent No. 1	N	-.571
May 5	3	No. fruits per plant	N	.498
		Wt. fruits per plant	N	.625
		Defects per fruit	N	.487
		Cracking	N	.707
		Off Color	K	-.423
May 5	5	No. fruits per plant	N	.453
		Wt. fruits per plant	N	.495
		Defects per fruit	N	.382
		Puffiness	N	-.391
		Cracking	N	.697
		Off Color	K	-.348
		Per Cent No. 1	N	-.548
May 26	6	Defects per fruit	N	.364
		Cracking	N	.571
		Off Color	K	-.421
		Per cent No. 1	N	-.420

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Table 4

Correlations Between Leaf Content and Fruit Yield and Defects

OHIO WR 25 Spring Crop 1967

Date	Cluster	Yield or Defect	Nutrient	Correlation Coefficients
Feb. 10	1	Defects per fruit	N	.445
		Puffiness	N	.359
		Cracking	N	.349
		Scars	N	.339
		Per cent No. 1	N	-.490
March 3	2	Puffiness	N	.360
March 24	3	Defects per fruit	N	.434
		Cracking	N	.413
		Per cent No. 1	N	-.465
April 14	4	No. fruits per plant	N	.378
		Wt. fruits per plant	N	.456
		Defects per fruit	N	.598
		Puffiness	N	.461
		Cracking	N	.626
		Per cent No. 1	N	-.698
May 5	3	No. fruits per plant	N	.568
		Wt. fruits per plant	N	.581
		Defects per fruit	N	.450
		Cracking	N	.662
		Per cent No. 1	N	-.433
May 5	5	No. fruits per plant	N	.595
		Wt. fruits per plant	N	.634
		Defects per fruit	N	.551
		Puffiness	N	.436
		Cracking	N	.681
		Per cent No. 1	N	-.593
May 26	6	No. fruits per plant	N	.613
		Wt. fruits per plant	N	.543
		Cracking	N	.588
		Per cent No. 1	N	-.334

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Chart 3

Relation of Nitrogen and Potassium Applications to Yield and Quality of Greenhouse Tomatoes

Fall Crop 1967

Nitrogen and potassium were applied only on October 4.

The amounts of fertilizer added for applications were as follows:

Nitrogen (N)	Potassium (K)
0	0
10	19
32	63
55	106
65	125

The statistical analysis of the effect of applied nitrogen and potassium on yield and quality defects is present below.

OHIO-INDIANA HYBRID 0

Total defects per fruit

Only at the highest potassium level did defects increase with added nitrogen.

Puffiness

The smallest amount of puffiness wasobtained at the zero potassium and the 20 pounds treatment. The lowest amount occured at the two highest potassium levels (106 and 125 pounds of K).

Cracking

Cracking tended to be highest at the zero potassium level. Even at the highest potassium level, considerable cracking occurred. Nitrogen has no significant effect.

Scars

Relatively little effect of applied nitrogen and potassium was evident.

Off-Shape

Relatively little effect of applied nitrogen or potassium was obtained.

Percent of No. 1 fruits

The percentage of No. 1 at the highest potassium level was lowest with no nitrogen applied. The differences at the lower levels of potassium were not essentially different as far as nitrogen applications were concerned.

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Chart 3 Con't

Number of fruits per plant

At the lower and highest potassium levels the number of fruits decreased with added nitrogen. At the medium potassium level (63 pounds K) number of fruits increased to the median nitrogen level.

Weight of fruits per plant

Generally the weight of fruits per plant tended to increase slightly at the 3 higher nitrogen levels although the differences were not large. This was true at all potassium levels.

Weight per fruit

The weight per fruit tended to be greater at the higher nitrogen levels.

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Table 5

Correlations Between Leaf Content and Fruit Yield and Defects

OHIO-INDIANA HYBRID O Fall Crop 1967

Date	Cluster	Yield or Defect	Nutrient	Correlation Coefficients
Sept 5	1	Off Shape	N	.368
	2	Defects per fruit	K	-.370
		Cracking	K	-.484
	3	Defects per fruit	K	-.413
		Cracking	K	-.588
		Per cent No. 1	K	.419
Sept 18	4	Defects per fruit	K	-.472
		Cracking	K	-.565
		Per cent No. 1	K	.366
Sept 25	1B	Defects per fruit	K	-.399
		Puffiness	N	-.428
		Cracking	K	-.437
		Per cent No. 1	K	.449
	1	Defects per fruit	K	-.342
		Cracking	K	-.473
		Scars	N	.360
		Weight per fruit	K	-.379
	2	Defects per fruit	N	.396
			K	-.444
		Cracking	N	.329
			K	-.580
		Scars	N	.331
		Off Shape	N	.339
			K	.412
	3	Defects per fruit	K	-.485
		Cracking	K	-.642
		Per cent No. 1	K	.447
		Weight per fruit	N	.333
Oct. 23	4	Defects per fruit	N	-.454
			K	-.589
		Cracking	N	-.402
			K	-.646
		Per cent No. 1	N	.435
			K	.549

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Table 5 Cont'd

Date	Cluster	Yield or Defect	Nutrient	Correlation Coefficients
Nov. 13	5	Defects per fruit	K	-.423
		Cracking	K	-.549
		Per cent No. 1	K	.391
		No. fruits per plant	N	.458
		Wt. fruits per plant	N	.484
		Weight per fruit	N	.322
Dec. 4	6	Defects per fruit	K	-.377
		Cracking	K	-.417
		Per cent No. 1	K	.331
		No. fruits per plant	N	.434
		Wt. fruits per plant	N	.383
		Weight per fruit	K	-.534
Dec 18	7	Defects per fruit	K	-.509
		Cracking	K	-.541
		Per cent No. 1	K	.440
		Wt. fruits per plant	N	.477
		Weight per fruit	N	.527

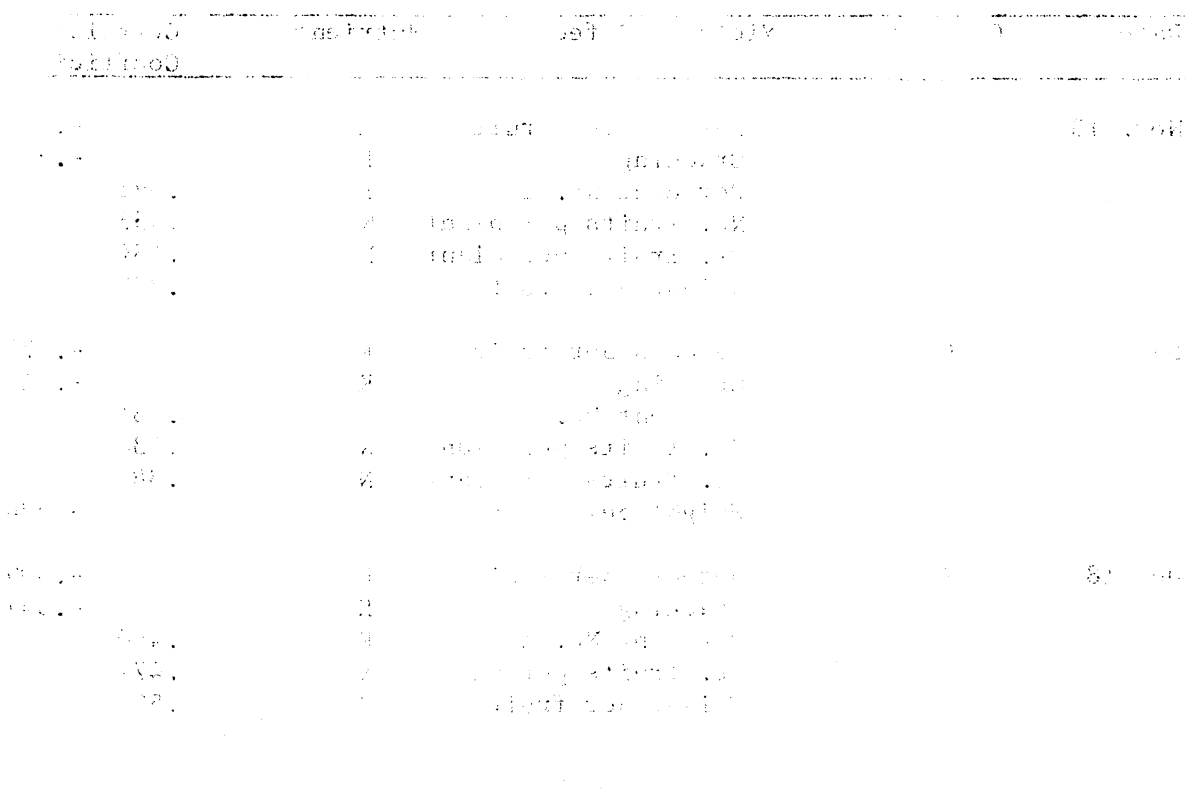

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Chart 4

Relation of Nitrogen and Potassium Application to Yield and Quality of Greenhouse Tomatoes

Spring Crop 1968

Nitrogen and potassium were applied on the following dates:

February 2
February 29
March 22
April 11
May 1
May 22

The total amount of elemental nitrogen and potassium applied per acre in pounds was as follows:

Nitrogen	Potassium (K)
0	0
120	228
390	750
660	1272
780	1500

The data obtained have been analyzed statistically. The particular results reported for this crop include the effect of the applications of nitrogen and potassium on the following yield and quality aspects.

OHIO WR 25

Total defects per fruit

Total defects per fruit increased to the medium nitrogen level (390 lbs.) and then showed a decrease. Potassium applications had no effect.

Puffiness

Puffiness increased with added nitrogen. It tended to be greatest at the medium potassium level (750 lbs.). At this median level nitrogen had no effect whatsoever on puffiness.

Cracking

Cracking was high at the highest potassium level. Cracking tended to increase to and including the median level of nitrogen (390 lbs.).

Burst fruit

Bursting tended to be highest at the lower nitrogen levels.

Percent of No. 1 fruits

Nitrogen and potassium applications had very little effect upon the percent of No. 1 fruits.

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Number of fruits per plant

Generally the number of fruits decreased as the nitrogen levels increased. At the lowest and highest potassium level the number of fruits did not decrease at the two highest nitrogen levels.

Percent of culls

Applied nitrogen and potassium had relatively little effect upon the percentage of culls.

OHIO-INDIANA HYBRID O

Total defects per fruit

Defects tended to increase to the median level of nitrogen and then to decrease.

Puffiness

Puffiness increased with increased nitrogen until a median level of nitrogen was attained. Thereupon decrease occurred.

Cracking

Cracking increased up to and including the median nitrogen treatment. Thereupon a decrease tended to occur. Cracking was highest at the two highest potassium applications.

Burst fruits

Burst fruits were higher at the lowest nitrogen levels. The number was the highest at the zero nitrogen level.

Percent of No. 1 fruits

Practically no effect of nitrogen or potassium was evident on the percent of fruits grading No. 1.

Number of fruits per plant

The number of fruits decreased as the nitrogen level increased. Only at the median potassium level was there no significant effect of leaf nitrogen.

Percent of culls

Culls decreased with added nitrogen at two lowest potassium levels. In the three upper potassium levels culls were highest at the median nitrogen level. Thereupon, a decrease occurred at the fourth and fifth nitrogen levels.

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Table 6

Correlations Between Leaf Content and Fruit Yield and Defects

OHIO WR 25 Spring Crop 1968

Date	Cluster	Yield or Defect	Nutrient	Correlation Coefficients
Feb 19	1	Defects per fruit	N	.460
		Per cent No. 1	N	-.340
		No. fruits per plant	N	.376
		Weight per fruit	K	-.351
Feb. 28	2	Defects per fruit	N	.563
		Cracking	N	.611
		Per cent No. 1	K	-.416
		No. fruits per plant	N	.361
		Wt. fruits per plant	N	.501
		Weight per fruit	N	.549
		Per cent of culls	K	.399
March 21	3	Defects per fruit	N	.769
		Puffiness	N	-.811
		Cracking	N	-.823
		Burst fruits	N	-.882
		Rough fruits	N	-.804
		Off Color	N	-.886
		Scars	N	-.837
		Blossom-end rot	N	-.870
		Catfaced fruit	N	-.882
		Per cent No. 1	N	-.885
		No. fruit per plant	N	.803
		Wt. fruits per plant	N	.801
		Weight per fruit	N	-.855
		Per cent of culls	N	.698
			K	.363
April 10	4	Defects per fruit	N	.446
		Puffiness	K	-.346
		Cracking	N	.424
		Blossom-end rot	K	.331
		Per cent No. 1	K	-.364
		No. fruits per plant	N	.465
		Wt. fruits per plant	N	.478
April 30	5	Defects per fruit	N	.529
		Puffiness	K	-.423
		Cracking	N	.529
		Per cent No. 1	K	-.384
		No. fruits per plant	N	.581
		Wt. fruits per plant	N	.646
		Per cent of culls	K	.356

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Table 6 Cont'd

Date	Cluster	Yield or Defect	Nutrient	Correlation Coefficients
May 20	6	Defects per fruit	N	.342
		Puffiness	N	-.371
			K	-.366
		Cracking	N	.564
		Burst fruits	N	.418
		Per cent No. 1	K	-.365
		No. fruits per plant	N	.767
		Wt. fruits per plant	N	.757
June 10	3	None		
	7	Defects per fruit	N	.502
		Puffiness	N	-.377
			K	-.399
		Cracking	N	.534
		Burst fruits	N	.400
			K	.379
		Blossom-end rot	N	.397
		Per cent No. 1	N	-.402
			K	-.399
		No. fruits per plant	N	.720
		Wt. fruits per plant	N	.687
		Per cent of culls	N	.351
			K	.372

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Table 7

Correlations Between Leaf Content and Fruit Yield and Defects

OHIO-INDIANA HYBRID O — Spring Crop 1968

Date	Cluster	Yield or Defect	Nutrient	Correlation Coefficients
Feb. 19	1	Defects per fruit	N	.493
		Cracking	N	.447
		Off Shape	N	.464
		Blossom-end rot	N	.526
		Per cent No. 1	N	-.482
		No. fruits per plant	N	.589
		Wt. fruits per plant	N	.543
		Per cent of culls	N	.540
Feb. 28	2	Defects per fruit	N	.438
		Cracking	N	.475
		Off Color	N	-.344
			K	-.454
		Per cent No. 1	N	-.358
		No. fruits per plant	N	.437
		Wt. fruits per plant	N	.570
		Weight per fruit	N	.587
		Per cent of culls	N	.406
March 21	3	Defects per fruit	N	.344
		Cracking	N	.469
		Off Color	K	-.332
		Off Shape	K	.343
		Blossom-end rot	K	.401
		No. fruits per plant	N	.421
			K	.331
		Wt. fruits per plant	N	.517
			K	.344
		Weight per fruit	N	.488
April 10	4	Defects per fruit	N	.471
		Cracking	N	.468
		Scars	N	.381
			K	.387
		Off Color	N	-.332
		Blossom-end rot	K	.394
		Per cent No. 1	N	-.394
		No. fruits per plant	N	.460
		Wt. fruits per plant	N	.566
		Weight per fruit	N	.550
		Per cent of culls	N	.355

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Table 7 Cont'd

Date	Cluster	Yield or Defect	Nutrient	Correlation Coefficients
April 30	5	Defects per fruit	N	.334
		Cracking	N	.346
		Burst fruits	N	.362
		Off Color	N	-.381
		Blossom-end rot	N	.387
		No. fruits per plant	N	.471
		Wt. fruits per plant	N	.531
		Weight per fruit	N	.432
May 20	6	Defects per fruit	N	.509
		Cracking	N	.526
		Burst fruits	N	.361
		Off Shape	N	.389
		Per cent No. 1	N	-.428
		No. fruits per plant	N	.739
		Wt. fruits per plant	N	.796
		Weight per fruit	N	.572
		Per cent of culls	N	.464
June 10	3	Off Color	K	-.376
		Off Shape	K	.349
	7	Defects per fruit	N	.459
		Cracking	N	.555
		Per cent No. 1	N	-.331
		No. fruits per plant	N	.732
		Wt. fruits per plant	N	.743
		Weight per fruit	N	.455
		Per cent of culls	N	.384

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